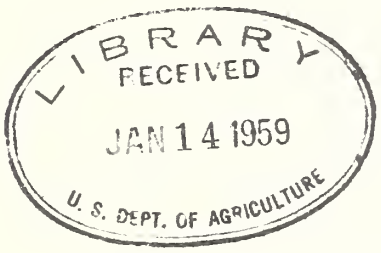
SOURCES AND CAUSES OF INCREASED FARM PRODUCTION IN THE UNITED STATES

Implications for Indian Agriculture



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SOURCES AND CAUSES OF INCREASED FARM PRODUCTION IN THE UNITED STATES

Implications for Indian Agriculture[1/]

I. The Production Revolution

The United States has experienced a revolution in farm production since just before World War II. The revolution occured in the sense that production changes underway during the interwar period were greatly accelerated during the years of World War II and the postwar period. The average annual increase in farm output during World War II and the postwar years was 2½ times that recorded during the period between the two World Wars. Farm output in 1955-57 was 40 percent greater than in 1938-40. Livestock production increased by nearly 45 percent during this period and total outturn of crops rose by nearly 30 percent (table 1).

Productivity of agricultural resources rose sharply after the outbreak of World War II. Both crop production per acre and livestock production per breeding unit were more than a fourth greater in 1955-57 than in 1938-40. Output per man-hour of farm labor doubled.

Marked changes occurred also in the kinds and amounts of production resources used. Man-hours of farm labor decreased by more than 30 percent from just before World War II to 1955-57. Use of commercial fertilizer by farmers at the end of the period was nearly four times the volume used in 1938-40. Numbers of tractors tripled. Use of such nonfarm inputs as pesticides, formula feeds, and so on, expanded greatly.

II. Sources of Increased Output

The importance of the various sources of additional output differed greatly between the interwar period and the decade and a half following 1940 (table 2). The major source of greater output during the interwar period was associated with the shift in kind of power used by farmers. As tractors, motortrucks, and automobiles replaced horses and mules as sources of power,

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1/ Prepared for the International Cooperation Administration at the request of TCM, India, by Glen T. Barton and H. L. Stewart, Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture.

Table 1.-Farm production and related data, United States, specified periods, 1930-57

Item	Unit	1930-32	1938-40	1945-47	1955-57
Farm output	Index, 1947-49=100	76	81	96	113
Livestock production	do.	80	84	102	121
Crop production	do.	80	83	95	106
Crop production per acre of cropland used	do.	79	86	97	109
Production per animal breeding unit	do.	85	91	96	116
Farm output per man-hour	do.	57	67	90	137
Total man-hours used	do.	134	120	108	82
Fertilizer used	do.	31	44	87	169
Tractors on farms	Thousands	980	1,453	2,482	4,487

vast acreages of crop and pastureland and large amounts of labor and other resources were released from growing feed for maintenance of horses and mules to production of products for sale. This direct effect of mechanization accounted for half the rise in farm output during the interwar period. The contribution from this source increased in absolute importance during the World War II and postwar period but accounted for less than a fourth of the total added outturn of products for human use.

A large increase in crop production per acre was the major source of added output during the period following the outbreak of World War II. Nearly 45 percent of the increase in output came from this source during the later period compared with about a third during the interwar years. The greater quantity of fertilizer used on farms was a major factor in the step-up in farm production during the World War II and postwar years. It accounted for more than half the increase in crop production per acre and nearly a fourth of the addition to total farm output.

Although more favorable weather contributed to the sharp upturn in farm output since 1940, it is estimated that less than 10 percent of the increase was accounted for by this factor.

Changes in acreage of cropland and in total output of pasture were nominal sources of additional output during both periods. A greater volume of product added by livestock (production added in the conversion of feed into livestock and livestock products) contributed significantly to increase in output in both periods. This factor accounted for a fourth of the additional output during World War II and the postwar years when the outturn of feed grains and hay increased greatly and formed the basis for the sharp rise in livestock production.

Table 2.-Sources of change in farm output, United States, specified periods, 1919-55

Source	Interwar, 1919-21 to 1938-40		World War II and postwar, 1940-41 to 1955	
	Index points per year 1/	Percentage of total	Index points per year 1/	Percentage of total
Reduction of farm-produced power	0.39	51	0.44	23
Change in crop production per acre:				
Shifts in crop acreage	.00	0	-.31	-16
Weather	-.12	-15	.18	9
Fertilizer	.08	10	.45	24
Hybrid corn	.05	7	.10	5
Irrigation	.01	1	.06	3
Other	.24	31	.34	18
Total	.26	34	.82	43
Change in cropland used	-.03	-4	.13	7
Change in product added by livestock	.12	15	.47	25
Change in pasture consumed by livestock	.03	4	.04	2
Total	.77	100	1.90	100

1/ Changes are measured in output index points, with the average of the years 1947-49 taken as a base period, or 100 points. This provides a measure of absolute change. For example, during the interwar period, the annual increase in production averaged 0.77 percent of the 1947-49 level of production; since 1940-41, it has averaged 1.90 percent annually.

Based on preliminary results of analysis by Donald D. Durost, Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture.

III. Causes of Greater Output

The rapid expansion of farm output during World War II and the immediate postwar years resulted when favorable price relationships and incomes to farmers provided the economic incentives to exploit the reserves of research results and education that had accumulated over a long period of years.

A. Technical, Educational, and Institutional Reserves

United States agriculture entered World War II with a vast storehouse of available technical knowledge. The technical basis for rapid expansion in farm output existed during the interwar period, but the economic incentive for rapid adoption of improved production practices was absent.

The educational reserves of United States agriculture at the beginning of World War II were important prerequisites for the upsurge in production. Literacy was almost universal and farmers and farmworkers had achieved significant educational levels as a result of the long-time compulsory public school system. The Federal-State Extension Service, which was initiated in 1914, also contributed to the educational reserve. During the years, and especially during the period following World War I, extension workers had acquainted many farmers with newer and better production practices. As noted above, the lag in adoption by farmers of these improved practices was largely accounted for by the lack of economic incentive.

The extent and coverage of the Extension Service was expanded during the 1930's in connection with the initiation of various Federal farm programs. The farm programs, in turn, added to the educational reserves of farmers regarding improved production practices. This was especially true of soil-improvement practices and use of lime and fertilizer which were partly subsidized under the farm programs.

The highly developed marketing and transportation system in the United States was an important asset and prerequisite for the rapid expansion in farm output after 1940. The marketing system not only gave assurance to farmers that their products could be marketed quickly and efficiently, it made possible rapid and timely movement to farms of fertilizer, machinery, and other nonfarm goods so important in modern commercial agriculture.

Changes in credit and tenure institutions had little causal effect in the rapid expansion in farm production at the outbreak of World War II. However, both public and private credit agencies were in position to provide promptly the production loans needed by farmers, and tenant operators were assured an equitable share of profits.

Although in 1940 about 40 percent of the farm operators of the United States were tenants, the preponderance of commercial family-type farms, and the kinds of leasing arrangements that prevailed, provided a favorable base for greater output on individual farms. The existing tenure institution helped assure that economic incentives would be translated rapidly into

greater outturn of crops and livestock products. In general, farm operators retained the profits that resulted from additional production, and tenants and landlords shared equitably in the profits.

Without these technical, educational, and institutional reserves, the rapid expansion in farm output after 1940 would not have been possible. It should be emphasized that these reserves were not built up in a short period; rather they had accumulated over a long period of time and especially during the interwar period.

B. Economic Incentives in World War II and the Postwar Years

The sharp expansion in demand for farm products after the outbreak of World War II resulted in price relationships and incomes to farmers that were very favorable to a rapid increase in farm production. The parity ratio stood at about 80 in the years immediately preceding World War II; by 1945-47, it had risen to 112 (table 3). Prices received for crops rose greatly relative to prices of fertilizer. This was a chief factor in the marked increase in use of commercial fertilizer during the period. But even with favorable technical, educational and economic conditions, a subsidy was required to induce a marked initial increase in the use of lime and fertilizer. Farm wage rates increased faster than other cost rates and helped to accelerate the trend toward mechanization of farming operations. Farm machinery became increasingly "cheap" relative to labor during the World War II and postwar period.

The existence of ample nonfarm employment opportunities, together with the attraction of greater per capita incomes in the nonfarm sectors of the economy provided the incentive and the opportunity for a rapid migration of workers from farms. Loss of workers to nonfarm employment and the military service, together with rising farm wage rates, proved powerful incentives for further mechanization of agriculture which was an important direct source of added farm output during World War II and the postwar period.

The cost of improved seeds, pesticides, formula feeds, and other production supplies, which proved to be key factors in the upsurge of farm output, were good "buys" for farmers in the same sense that fertilizer was a good buy. The increase in cash income to farmers provided an important means of financing the investments needed in expanding the productive capacity of agriculture.

The decrease in farm employment and the rapid expansion in mechanization were associated with important structural changes in agriculture (fig. 1). Commercial farms decreased in number and increased significantly in average size. Probably this development also added to farm output. The relatively more aggressive and progressive farmers gained control of a greater proportion of farm resources, and the larger farms were better suited to mechanized farming.

Table 3.-Farm price relationships and related economic data, United States, specified periods, 1930-57

Item	Unit	1930-32	1938-40	1945-48	1955-57
Ratio of prices received to prices paid	Index 1910-14=100	69	79	112	83
Ratio of prices received for crops to fertilizer prices	do.	73	84	185	157
Ratio of farm wage rates to prices paid, interest, taxes and wage rates	do.	107	104	183	187
Ratio of farm wage rates to farm machinery prices	do.	95	83	207	162
Nonagricultural employment 1/	Thousands	32,000	36,217	46,977	57,882
Proportion of total civilian labor force unemployed 2/	Percent	16	17	3	4
Ratio of farm income per agricultural worker to annual wage per employed factory worker	do.	30	38	72	44

1/ Survey of Current Business, Bureau of Census, U. S. Department of Commerce.

2/ Total unemployed divided by total civilian labor force. Data from same source as employment data.

Despite a lessening of overall economic incentive, farm output has continued to expand in the 1950's. The parity ratio in 1955-57, for example, was 83 compared with 112 in 1945-47 (table 3). A basic reason for the continued expansion in output is illustrated by the data in table 4. Even with much lower relative prices, it is still profitable for the individual farmer to adopt improved production practices and increase farm output. In the example given in table 4, it would be profitable for the farm operator to expand output (gross income in constant prices) by 35 to 40 percent under either level of relative prices.

An individual farmer may have received 6 to 8 dollars of additional return for each extra dollar spent for fertilizer during the war and immediate postwar years, compared with only 3 dollars of additional return per

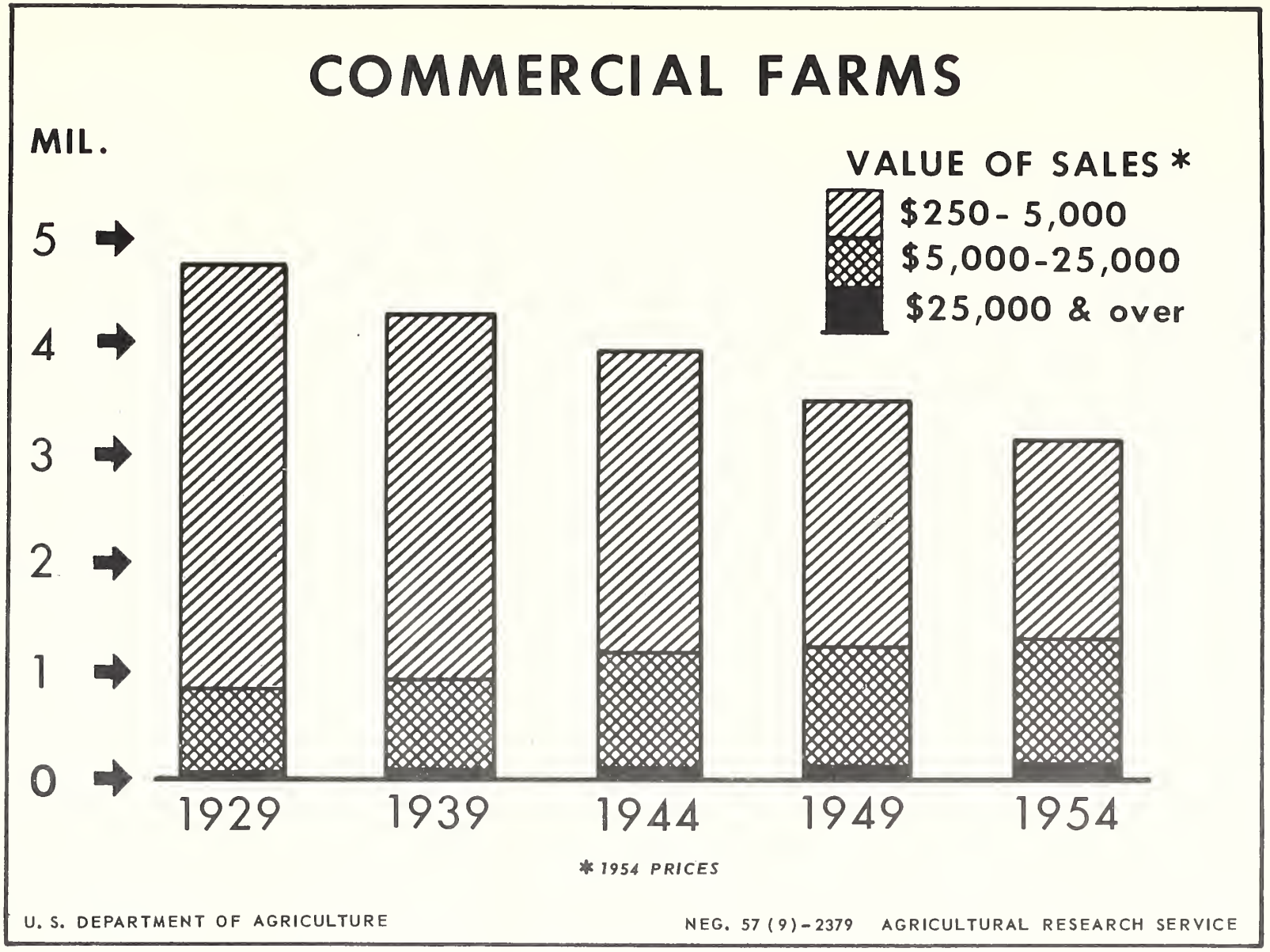
COMMERCIAL FARMS
MIL.
5
4
3
2
1
0
VALUE OF SALES *
$250- 5,000
$5,000-25,000
$25,000 & over
1929
1939
1944
1949
1954
* 1954 PRICES
U. S. DEPARTMENT OF AGRICULTURE
NEG. 57 (9)-2379 AGRICULTURAL RESEARCH SERVICE

Figure 1

Table 4.-Effects of suggested improvements in farming on expenses and income of a 2-man dairy farm, southeastern Michigan

Item	Present organization	Suggested organization	Increase over present organization	Percentage change
	Dollars	Dollars	Dollars	Percent
		High Prices[1/]		
Total expenses	11,675	13,761	2,086	18
Total gross income	15,024	20,519	5,495	37
Family labor income	3,349	6,758	3,409	102
		Medium Prices[2/]		
Total expenses	9,368	11,259	1,891	20
Total gross income	10,180	14,187	4,007	39
Family labor income	812	2,928	2,116	260

1/ Ratio of prices received for farm products sold to prices paid for items for use in production at 115 (1910-14=100).
2/ Ratio of prices received for farm products sold to prices paid for items for use in production at 84 (1910-14=100).

C. R. Hoglund, "Economy of Improved Production Practices on Specialized Dairy Farms in Southeastern Michigan," Ag. Econ. Report 491, 1952. (Cooperative study, U. S. Department of Agriculture and Michigan State College.)

fertilizer dollar by 1955-57. But the lower ratio of marginal returns to marginal costs is still highly profitable. Similarly, expenditures for pesticides, improved seeds, formula feeds, and additions to land area of going farms offer additional opportunities to increase output at marginal costs below prospective prices of farm products. These opportunities for lowering marginal unit costs of production on going farms continue to provide strong economic incentives for additions to volume of farm output per farm and in the aggregate.

IV. Applicability to Indian Conditions

Many of the factors that have contributed significantly to increased agricultural production in the United States can be used effectively in underdeveloped countries such as India. However, there are significant differences in the resources of these two countries, both physical and human, as well as in their stages of economic development and in the mores and motivations of the people, all of which affect greatly the opportunities to increase agricultural production.

Of the more important physical factors that contribute to increased productivity in the United States, increased use of fertilizer probably is one of the most promising for India. However, the entrepreneur who makes the production decisions will have to be given the know-how, adequate capital, and some assurance that he will receive a fair return for his efforts, his risk, and his investment. This would necessitate, of course, an elimination of any excessive rental charges. It should be kept in mind too, that even in a highly developed country such as the United States where know-how was the rule and where credit and tenure institutions were not serious obstacles, government programs and subsidies were required for marked initial increases in the use of fertilizer and lime.

Reductions in farm-produced power to make way for mechanized equipment offer little immediate promise in India because of fragmentary and scattered small holdings, credit and tenure obstacles, and a dearth of mechanical training and aptitude. However, if a permissible way were found to curtail numbers of cattle, it is possible than an even greater increase in production than that accompanying reductions in numbers of horses and mules in the United States would be possible.

Opportunities for changes in product added by livestock also appear to be limited. The pressure of population on the land and the accompanying incentives for direct food crops, as well as the prevalent religious ban on consumption of livestock limit greatly any such opportunities.

It seems plausible that expanded and improved irrigation facilities might offer opportunities for expanded production in India as great as those in the United States. Provision would have to be made, however, for adequate water supplies, power, improved pumps, and the know-how, capital, and assurance of fair returns referred to above.

Even greater limitations than the physical and institutional factors mentioned above are those associated with the stage of economic development of the country and with the mores and motivations of the people. Problems of communication, which arise primarily from the educational level of the people and from their language barriers, are an outstanding example. They encompass the problem of conveying to the cultivator both the production and the marketing know-how required to increase production and to obtain a fair return, knowledge of the advantages and the availability of adequate credit at reasonable rates, and knowledge of a dependable market.

Assurance of a dependable market is expecially important--a market that stands ready to provide desired goods and services in exchange for products sold, to reimburse the cultivator for product differentiation and for quality of product, and to avoid excessive waste and other risks at the expense of the cultivator. This includes provision for adequate transport and storage facilities, product inspection, weight and measure guarantees, informed consumers, and all the other factors long since taken for granted by the American producer but still unknown to the Indian cultivator.

Hand in hand with the requirement of a dependable market and all that it implies is the requirement of a developing industrial economy--an economy which will provide the consumers for agricultural products, consumer goods desired by the cultivators, producer goods required to increase the productivity of agriculture, and foreign exchange required for imports essential to agricultural development. The importance of the industrial revolution in the expansion of agricultural productivity in America frequently is overlooked.

Differences between Indian cultivators and American farmers in their mores and motivations comprise another obstacle to increased production which probably will be the most difficult of all to overcome. The American farmer takes great pride in his prowess as a business man. To him, farming also is a way of life, but his major motivation is that of increasing his income. In contrast, farming to the Indian cultivator apparently is a means of survival. His wants are limited, his living standards at minimum levels. He would readily sacrifice opportunities to increase his production and his living standards in order to provide an acceptable dowry for his daughters.

India is making tremendous strides in her development, both industrially and agriculturally. She can learn a great deal from our experience in the United States. Her educational program, her research program, her Extension Service and Community Development programs, all promise to enhance her agricultural production. But she has many limitations and many obstacles to overcome and it does not seem reasonable to expect her to increase her production as rapidly as has the United States since World War II.